

SCI7661C/M Series

CMOS DC/DC CONVERTER

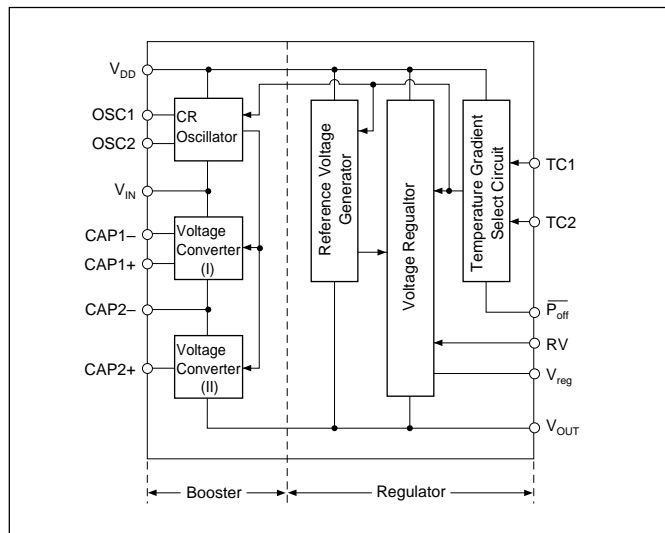
DESCRIPTION

The SCI7661C/M CMOS DC/DC Converter features high operational performance with low power dissipation. It consists of two major parts: the booster circuitry and the regulator circuitry. The booster generates a doubled output voltage ($-2.4V$ to $-12V$) or tripled output voltage ($-3.6V$ to $-18V$) from the input ($-1.2V$ to $-6V$). The regulator is capable of setting the output to any desired voltage. The regulated voltage can be given one of three threshold temperature gradients.

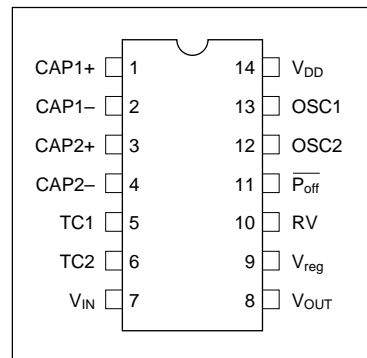
FEATURES

- High performance with low power dissipation
- Simple conversion of V_{IN} ($-5V$) to $|V_{IN}|$ ($+5V$), $2|V_{IN}|$ ($+10V$), $2V_{IN}$ ($-10V$) or $3V_{IN}$ ($-15V$)
- On-chip output voltage regulator
- Power conversion efficiency Typ 95%
- Temperature gradient for LCD power supply $0.1\%/^{\circ}C$, $0.4\%/^{\circ}C$ or $0.6\%/^{\circ}C$
- Power off by external signals — Stationary current at power off ... Max $2\mu A$
- Cascade connection — two devices connected $V_{IN} = -5V$, $V_{OUT} = -20V$
- On-chip C-R oscillator
- Package SCI7661COA .. DIP-14pin (plastic)
SCI7661MOA .. SOP5-14pin (plastic)

BLOCK DIAGRAM



PIN CONFIGURATION



The same pin configuration in DIP and SOP

■ PIN DESCRIPTION

Pin Name	Pin No.	Function
CAP1+, CAP1–	1, 2	Terminal for connection of capacitor for doubler
CAP2+, CAP2–	3, 4	Terminal for connection of capacitor for tripler
TC1, TC2	5, 6	Temperature gradient selection terminal
V _{IN}	7	Power supply terminal (negative, system supply GND)
V _{OUT}	8	Output terminal at tripling
V _{reg}	9	Regulated voltage output terminal
RV	10	Regulated voltage control terminal
P _{off}	11	V _{reg} output ON/OFF control terminal
OSC2, OSC1	12, 13	Oscillation resistor connection terminal
V _{DD}	14	Power supply terminal (positive system supply V _{CC})

■ ABSOLUTE MAXIMUM RATINGS

(V_{DD}=0V)

Parameter	Symbol	Ratings	Unit
Input supply voltage	V _I	–20/N* ¹ to 0.5	V
Input terminal voltage	V _I	V _{IN} –0.5 to 0.5	* ² V
		V _{OUT} –0.5 to 0.5	* ³ V
Output voltage	V _O	min. –20.0	V
Allowable loss	P _d	300	mW
Operating temperature	T _{opr}	–30 to 85	* ⁴ °C
Storage temperature	T _{stg}	–55 to 150	°C
Soldering temperature and time	T _{sol}	260°C, 10s (at lead)	—

*¹ N=2: Doubler; N=3: Tripler*² OSC1, P_{off}*³ TC1, TC2, RV*⁴ Plastic package

Additional Note: When this IC is soldered in the solder-reflow process, be sure to maintain the reflow furnace temperature at the curve shown in “Figure 3–5 Reflow Furnace Temperature Curve” of DATA BOOK. And this IC cannot be exposed to high temperature of the solder dipping.

■ ELECTRICAL CHARACTERISTICS

(V_{DD}=0V, V_{IN}=-5V, T_a=-30° to 85°C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input supply voltage	V _I		-6.0		-1.2	V
Output voltage	V _O		-18.0			V
	V _{reg}	R _L =∞, R _{RV} =1MΩ, V _O =-18V	-18.0		-2.6	V
Regulator operating voltage	V _{OUT}		-18.0		-3.2	V
Booster current consumption	I _{opr1}	R _L =∞, R _{OSC} =1MΩ		60	100	μA
Regulator current consumption	I _{opr2}	R _L =∞, R _{RV} =1MΩ, V _O =-15V		5.0	12.0	μA
Stationary current	I _Q	TC2=TC1=V _{OUT} , R _L =∞			2.0	μA
Oscillation frequency	f _{OSC}	R _{OSC} =1MΩ	16	20	24	kHz
Output impedance	R _{OUT}	I _{OUT} =10mA		150	200	Ω
Booster power conversion efficiency	P _{eff}	I _{OUT} =5mA	90	95		%
Regulated output voltage fluctuation	$\frac{\Delta V_{reg}}{\Delta V_{OUT} \cdot V_{reg}}$	-18V < V _{OUT} < -8V, V _{reg} =-8V, R _L =∞, T _a =25°C		0.2		% / V
Regulated output load fluctuation	$\frac{\Delta V_{reg}}{\Delta I_{OUT}}$	V _{OUT} =-15V, V _{reg} =-8V, 0 < I _{OUT} < 10mA, T _a =25°C, TC1=V _{DD} , TC2=V _O		5		Ω
Regulated output saturation resistance	R _{SAT}	R _{SAT} =Δ(V _{reg} -V _{OUT})/ΔI _{OUT} , 0 < I _{OUT} < 10mA, R _V =V _{DD} , T _a =25°C		8		Ω
Reference voltage	V _{RV0}	TC2=V _{OUT} , TC1=V _{DD} , T _a =25°C	-2.3	-1.5	-1.0	V
	V _{RV1}	TC2=TC1=V _{OUT} , T _a =25°C	-1.7	-1.3	-1.1	V
	V _{RV2}	TC2=V _{DD} , TC1=V _{OUT} , T _a =25°C	-1.1	-0.9	-0.8	V
Temperature Gradient	C _{T0}	$CT = \frac{ V_{reg}(50^{\circ}C) - V_{reg}(0^{\circ}C) }{50^{\circ}C - 0^{\circ}C} \times \frac{1}{ V_{reg}(25^{\circ}C) } \times 100$	-0.25	-0.1	-0.06	% / °C
	C _{T1}		-0.5	-0.4	-0.3	% / °C
	C _{T2}		-0.7	-0.6	-0.5	% / °C
Input leakage current	I _L	P _{off} , TC1, TC2, OSC1, RV pins			2.0	μA

■ RECOMMENDED OPERATING CONDITIONS

(T_a=-30° ~ 85°C)

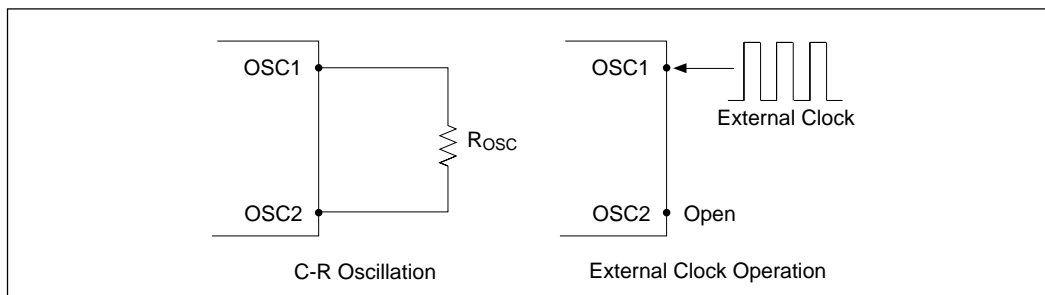
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Booster start voltage	V _{STA1}	R _{OSC} =1MΩ, C ₃ ≥ 10μF *2 C _L /C ₃ ≤ 1/20, T _a =-20° to 85°C			-1.2	V
	V _{STA2}	R _{OSC} =1MΩ			-2.2	V
Booster stop voltage	V _{STP}	R _{OSC} =1MΩ	-1.2			V
Output load resistance	R _L		R _L min *3			Ω
Output load current	I _{OUT}				20	mA
Oscillation frequency	f _{OSC}		10		30	kHz
External resistance for oscillation	R _{OSC}		680		2000	kΩ
Capacitor for booster	C1, C2, C3		3.3			μF
Regulated output adjustable resistance	R _{RV}		100		1000	kΩ

*1 V_{DD}=0V*2 Recommended circuitry in low voltage operation is shown below (next page, diagram on left)
(V_{IN}=-1.2V~-2.2V)*3 R_L min depends on input voltage as shown below (next page, diagram on right)

■ CIRCUIT DESCRIPTION

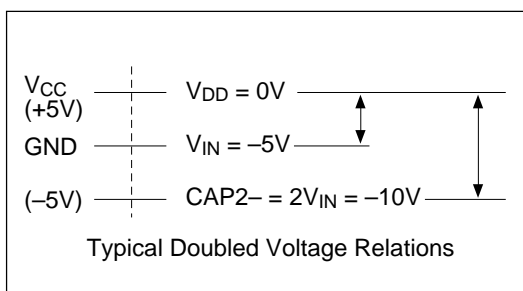
● C-R Oscillator

The SCI7661C/M contains a C-R oscillator for internal oscillation. It consists of an external resistor R_{osc} connected between the OSC1 pin and OSC2 pin.

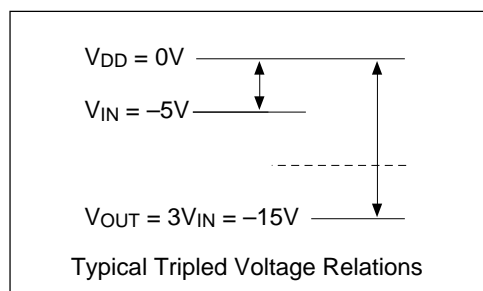


● Voltage Converters

The voltage converters double/triple the input supply voltage (V_{IN}) using clocks generated by the C-R oscillator.



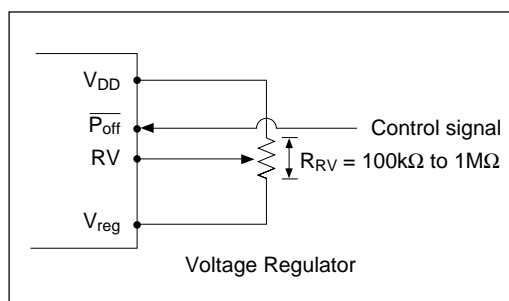
Typical Doubled Voltage Relations



Typical Tripled Voltage Relations

● Reference Voltage Generator and Voltage Regulator

The reference voltage generator produces reference voltage needed for operation of regular circuit. The voltage regulator is used to regulate a boosted output voltage and its circuit contains a power-off function which uses signals from the system for on-off control of the V_{reg} output.



Voltage Regulator

● Temperature Gradient Selector Circuit

The SCI7661C/M provides the V_{reg} output with a temperature gradient suitable for LCD driving (between V_{DD} and V_{reg}).

● Temperature Gradient Assignment

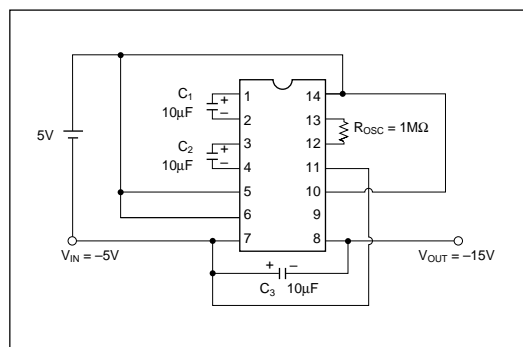
$\overline{P_{off}}$	TC2	TC1	Temp. Gradient	V _{reg} Output	CR oscillation	Remarks
1 (V _{DD})	L (V _{OUT})	L (V _{OUT})	-0.4% / °C	ON	ON	
1	L	H (V _{DD})	-0.1% / °C	ON	ON	
1	H (V _{DD})	L	-0.6% / °C	ON	ON	
1	H	H	-0.6% / °C	ON	OFF	Cascade connection
0 (V _{IN})	L	L	—	OFF (Hi-Z)	OFF	
0	L	H	—	OFF (Hi-Z)	OFF	
0	H	L	—	OFF (Hi-Z)	OFF	
0	H	H	—	OFF (Hi-Z)	ON	Without regulation

NOTE: The potential at Low level is different between the $\overline{P_{off}}$ pin and the TC1/TC2 pin.

■ EXAMPLE OF APPLICATIONS

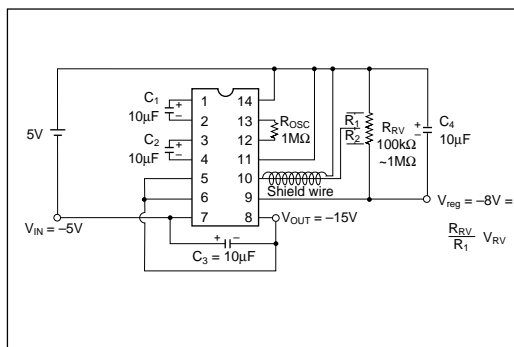
● Voltage Doubler and Tripler

A doubled voltage can be obtained at V_{OUT} (CAP2-) by disconnecting capacitor C₂ from the tripler configuration and shorting CAP2- (pin 4) and V_{OUT} (pin 8).



● Voltage Tripler + Regulator

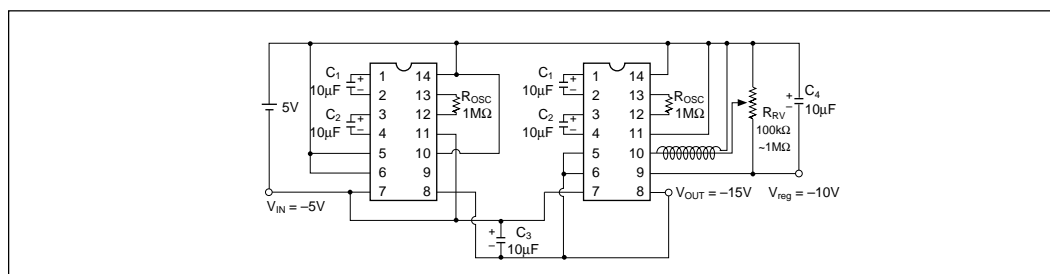
V_{reg} output is given a temperature gradient, after boosted output V_{OUT} regulated. In this connection, both V_{OUT} and V_{reg} can be taken out at the same time.



● Parallel Connection

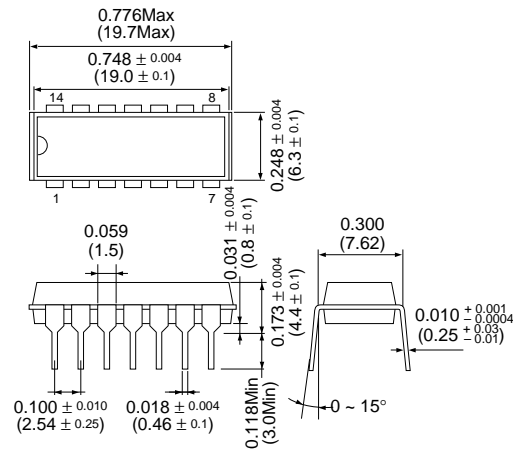
Parallel connection of n circuits can reduce R_{OUT} to about 1/n, that output impedance R_{OUT} can be reduced by connecting serial configuration. A single smoothing capacitor C₃ can be used commonly for all parallelly connected circuits.

In parallel connection, a regulated output can be obtained by applying the regulation circuit to only one of the n parallelly connected circuits.



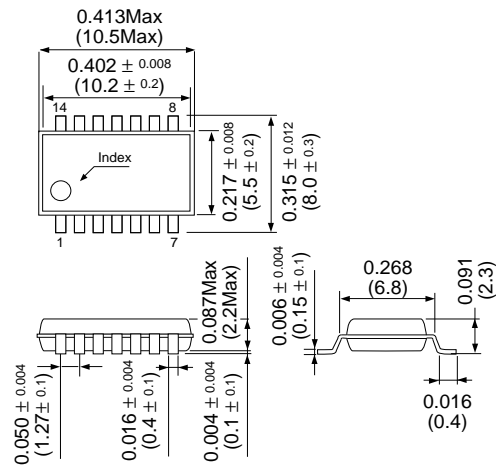
■ PACKAGE DIMENSIONS

Plastic DIP-14 pin



unit : inch (mm)

Plastic SOP5-14 pin



unit : inch (mm)